

Badger Army Ammunition Plant

Baraboo  
Sauk County  
Wisconsin

HAER No. WI-8

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56-BARAB,  
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WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record

National Park Service

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Attachment 22

## EXECUTIVE SUMMARY

The Badger Army Ammunition Plant (BAAP) is a government-owned, contractor-operated (GOCO) propellant plant located midway between Baraboo and Sauk City, Wisconsin. The installation is a part of the Army's Armament, Munitions and Chemical Command (AMCCOM). One of six very similar smokeless powder plants constructed between 1940 and 1943 for the U.S. Army, the BAAP was expanded during the Korean and Vietnam wars, and is currently on standby and modernization status. Modernization activities include the construction of improved waste-handling facilities and the limited modification of existing production equipment. Present facilities include production lines for single-base smokeless powder, double-base propellant, smokeless ball powder, nitrocellulose, nitroglycerine, sulphuric and nitric acid, and a variety of solvents. The current operating contractor is Olin Corporation.

The 7,417-acre site presently contains 1,612 buildings, 1,338 of which were constructed during World War II and house equipment from that era. The majority of the buildings were constructed for temporary use and are utilitarian in nature. There are no Category I or II historic properties at the BAAP. The Ball Powder facilities constructed during 1954-55 -- a good example of a highly intact industrial process, and the only such facilities at a GOCO plant in the United States -- are Category III historic properties.

## Chapter 2

### HISTORICAL OVERVIEW

#### BACKGROUND

The Badger Army Ammunition Plant (BAAP) is located on the Sauk Prairie of south-central Wisconsin, between the Baraboo Range and the Wisconsin River. Settled in the 1840's, this tract of rich prairie land was farmed intensively until its acquisition by the Army in 1942. The original plans for the Badger Ordnance Works (now BAAP) called for three smokeless powder production lines, as well as support facilities to manufacture diphenylamine and sulphuric acid. Construction began in February 1942 and continued throughout World War II, as expanded plans called for additional smokeless powder facilities and added production areas for double-base rocket propellant and nitric acid. TNT facilities and an additional smokeless powder line, under construction when the plant was shut down in 1945, were never completed.

Following World War II the plant was placed on standby status. Rehabilitation for the Korean War began in February of 1951, and was completed in 1954. New facilities were constructed, and some existing ones modified, for the production of Ball Powder during 1954 and 1955. The plant was placed on standby status again on November 18, 1959, and remained inactive until March 28, 1966. Reactivation for the Vietnam War included the modernization of existing structures and equipment as well as limited new construction. Since 1975 the plant has been on standby and modernization status. At present the plant comprises 7,417 acres and 1,612 structures.

With the exception of minor alterations undertaken in the course of routine maintenance and modernization, the plant's World-War-II-era buildings and equipment remain largely intact.

For a more detailed understanding of the plant's architectural and technological history, it is necessary to look more closely at the site's three major production periods: World War II, the Korean War, and the Vietnam War.

#### WORLD WAR II PERIOD

As the probable involvement of the United States in World War II became increasingly evident, the Army established an office in Wilmington, Delaware, to oversee the planning and construction of new munitions-manufacturing facilities. The office, opened on July 1, 1937, studied the productive capacity of the nation's existing munitions plants and prepared estimates of future demand for powder and explosives. In collaboration with the Dupont and Hercules corporations, the office devised standard plans for the construction of smokeless powder and high explosive plants and selected possible sites for the new facilities.<sup>1</sup>

#### Site Selection and Former Land Use

The government's criteria for the siting explosives plants in general, and smokeless powder plants in particular, greatly limited the number of possible locations. The basic criteria included: distance from coasts and foreign borders; accessibility by two existing rail lines; proximity to a

dewatered in centrifuges in the Pre Dry Houses (Buildings 6709-1 to 28), and blended into a uniform paste in the Paste Breaker and Blender Houses (Buildings 6731-2 to 4). The paste was then rolled into sheets in the Roll Houses (Buildings 6807-1 to 61), which were cut to size and rolled into cylinders in the Slitting and Carpet Roll Houses (Buildings 6808-1 to 16). These rolls were then extruded through horizontal presses into single, perforated grains in the Press Houses (Buildings 6810-1 to 44). Final milling, inspection, and packing took place in the Milling Houses (Buildings 6814-1 to 10), Inspection Houses (Buildings 6816-1 to 10), and Packing Houses (Buildings 6817-1 to 4).

Total production of single- and double-base powder during World War II exceeded 260 million pounds.<sup>11</sup> The government placed BAAP on standby status on September 7, 1945, reducing the staff to a small force of government employees and Operating Contractor standby personnel.

#### KOREAN WAR PERIOD

In February 1951, the Corps of Engineers authorized the Fegles Construction Company of Minneapolis, Minnesota to rehabilitate the plant for activation during the Korean War. The Liberty Powder Defense Corporation, a subsidiary of Olin Corporation, succeeded the Hercules Powder Company as the operating contractor on the site in March 1951. Extrusion and finishing of rocket propellant was underway by September 1951, and the plant was fully operational on a continuous basis three months later. Production at that time included a variety of single and double-base propellants, as well as the necessary component acids and solvents.<sup>12</sup>

In the summer of 1952, the BAAP was first considered for the installation of facilities to produce "Western Ball Powder" -- a revolutionary type of smokeless powder developed in the 1930's by the Western Cartridge Company of East Alton, Illinois, a subsidiary of Olin Corporation.<sup>13</sup> In the Western process, smokeless powder was handled in a water-based slurry throughout most of the stages of production, eliminating the wringing, shredding, pressing, extruding, and cutting stages of conventional smokeless powder production.

Western Cartridge first produced "Ball Powder" on a large scale in the 1940s, and the U.S. Army purchased the product in increasing quantities for use in rifle ammunition. Military demand for the new powder grew dramatically during the Korean War, and in March 1954 designs for the new facility at the BAAP were approved.<sup>14</sup>

#### Construction

The H. K. Ferguson Company of Cleveland, Ohio completed the new facilities in July 1955. The buildings were unlike any others on the site. Constructed of poured, reinforced concrete slabs and columns, they were enclosed by glass and steel infill panels with diagonal steel tension straps to provide lateral stability. Examples of this construction type are the Solvent Receiving (Buildings 9502-1 to 6), Wet Screening (Building 9503), and Coating Houses (Buildings 9506-1 & 2; Figure 7).<sup>15</sup>

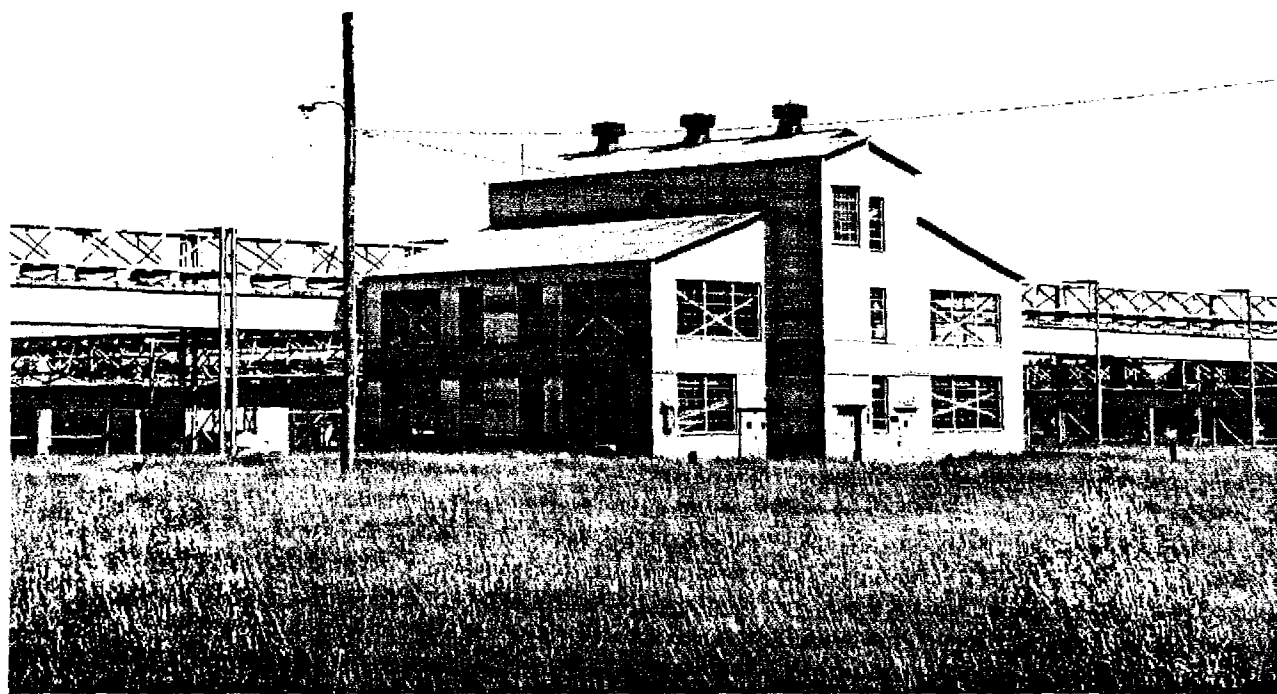


Figure 7: Typical reinforced concrete construction with glass and steel infill; ball powder Hardening and Weighing House. (Source: Field inventory photograph, Robert Ferguson, MacDonald and Mack Partnership, 1983)

### Technology

The production of double-base smokeless Ball Powder at the BAAP followed the steps developed at Western Cartridge:

The production of Ball Powder propellant, an Olin development... starts in a water slurry medium. Nitrocellulose, in a slurry with other ingredients and ethyl acetate solvent, is reduced to a lacquer form in agitated vessels. By controlled agitation and the successive addition of protective colloid and dewatering salt, the lacquer is dispersed into droplets of suitable diameter. The solvent is distilled off, leaving round hard balls of stabilized nitrocellulose in a water suspension. The unclassified balls are separated into sharply controlled granulation "cuts" by wet screening. The classified material in slurry form is impregnated with nitroglycerin and coated with dibutylphalate, an inert ballistic modifier, to control the burning rate. The coated material is dewatered in a continuous centrifuge, air dried, glazed with graphite (to improve loading characteristics and reduce static hazards), and blended. The finished product is extensively tested for ballistics performance characteristics. Final blending accomplishes uniformity, and the powder is packed into shipping containers.

The production of Ball Powder at the BAAP began in the Hardening Weigh and Solvent Receiving Houses (Buildings 9500-1 to 3, 9501-1 to 3, and 9502-1 to 6), where nitrocellulose was weighed, mixed in a water slurry with chemical modifiers and ethyl acetate solvent, agitated to produce droplets of the desired size, and stabilized by the addition of protective colloids, which hardened the floating droplets. The slurry then passed through a series of screens in the Wet Screening House (Building 9503), that separated the droplets into batches of nearly identical diameter. These sized batches were coated with chemical modifiers and nitroglycerine in the Coating Houses (Buildings 9506-1 and 2, and 9507-1 to 8). The slurry was dewatered in the Roll and Dewater Houses (Buildings 9509-1 and 2) and the finished balls were dried in the Tray Dry Houses (Buildings 9513-1 to 3).

The Ball Powder process had several advantages. The powder's slurry form, maintained during most of the process, greatly reduced chances of accidental explosion and eased transport of the material between production stages. The process also offered very precise control of grain size and shape, making for a uniform, predictable, propellant. But the most dramatic advantage was increased speed: finished powder could be produced in one-fifth the time previously required. The BAAP remains the only government-owned plant with complete facilities for smokeless Ball Powder production.<sup>17</sup>

Production during the Korean War included the products previously manufactured, with the addition of Ball Powder. Total production of single-base, double-base, and Ball Powder during the Korean War exceeded 280 million pounds.<sup>18</sup> On March 1, 1958, the BAAP returned to standby status, with the Olin Corporation providing maintenance.

#### VIETNAM WAR TO THE PRESENT

On January 3, 1966, the Olin Corporation reactivated the plant. It readied the Ball Powder area for operation by June 1966, and the rocket area and single-base smokeless powder areas by September 1966 and August 1967, respectively. The plant's total production of single-base, double-base, and Ball Powder during the Vietnam War exceeded 440 million pounds. All production at the BAAP ceased by June 1975, and the plant has remained on standby and modernization status, under the management of Olin Corporation, since that time.<sup>19</sup>